



D. B. D., photo.

HASSARD AND NEW SOURIS MINES.

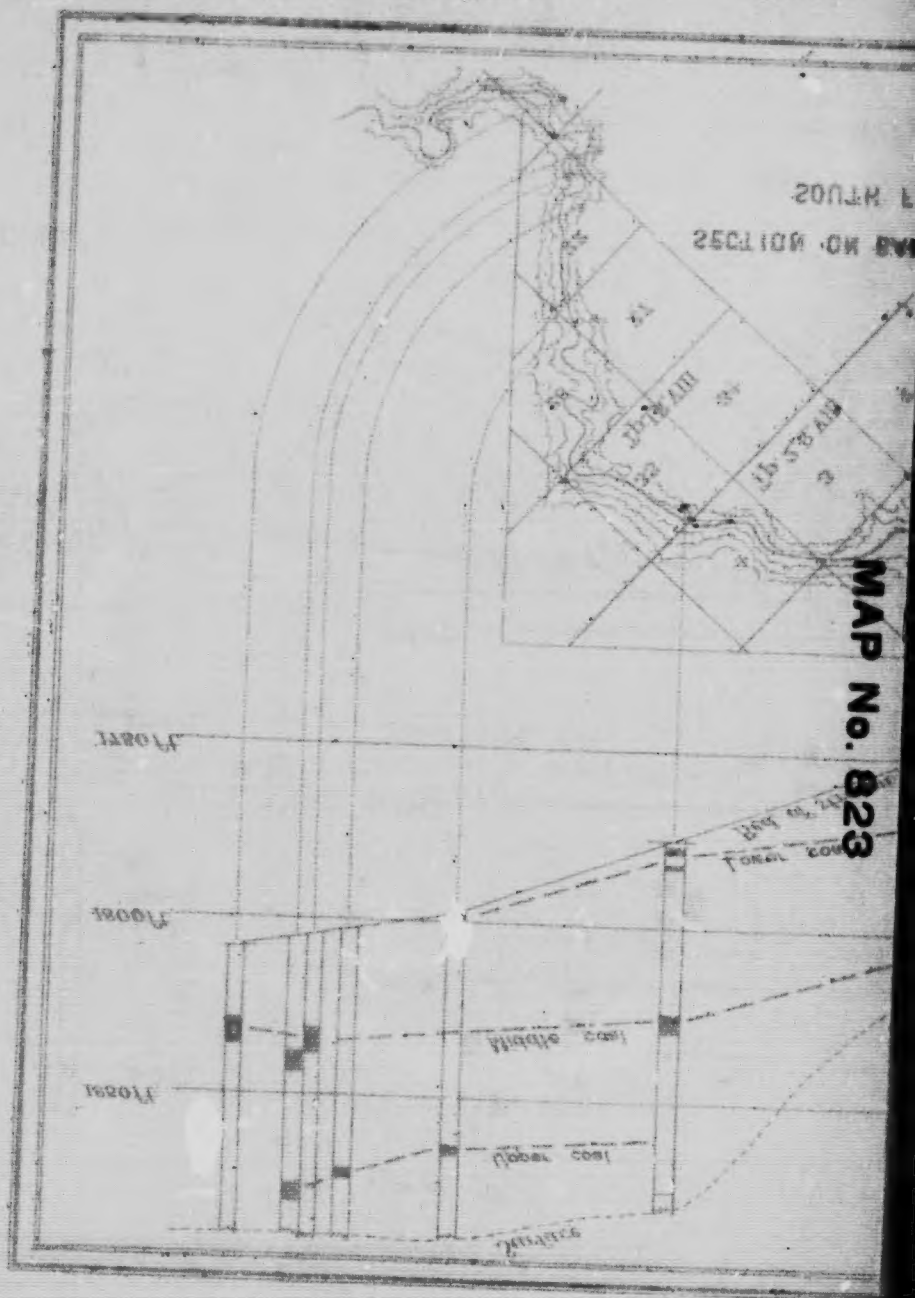
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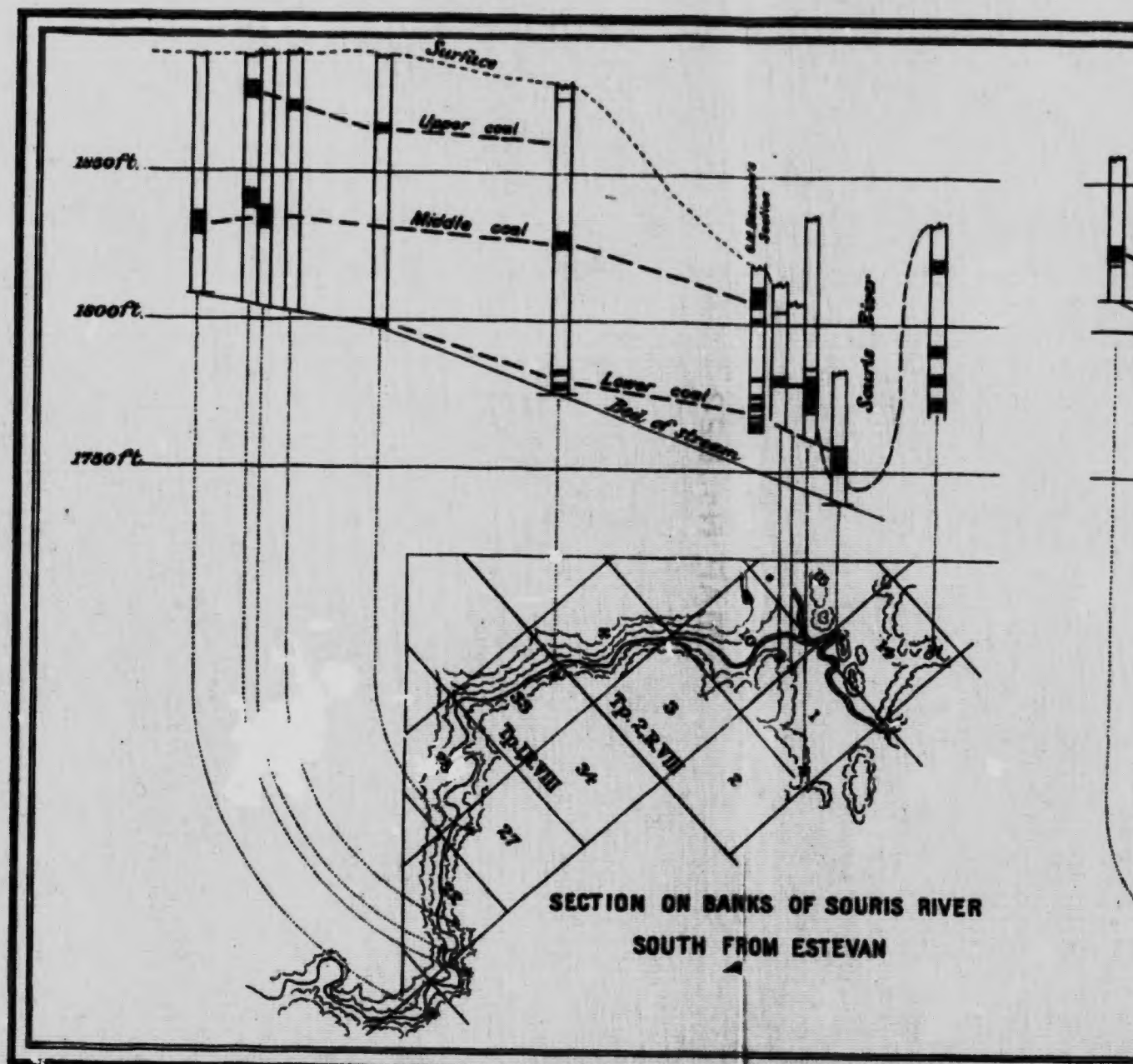


D. B. D., photo.

NEW SOURIS MINE.

1902.



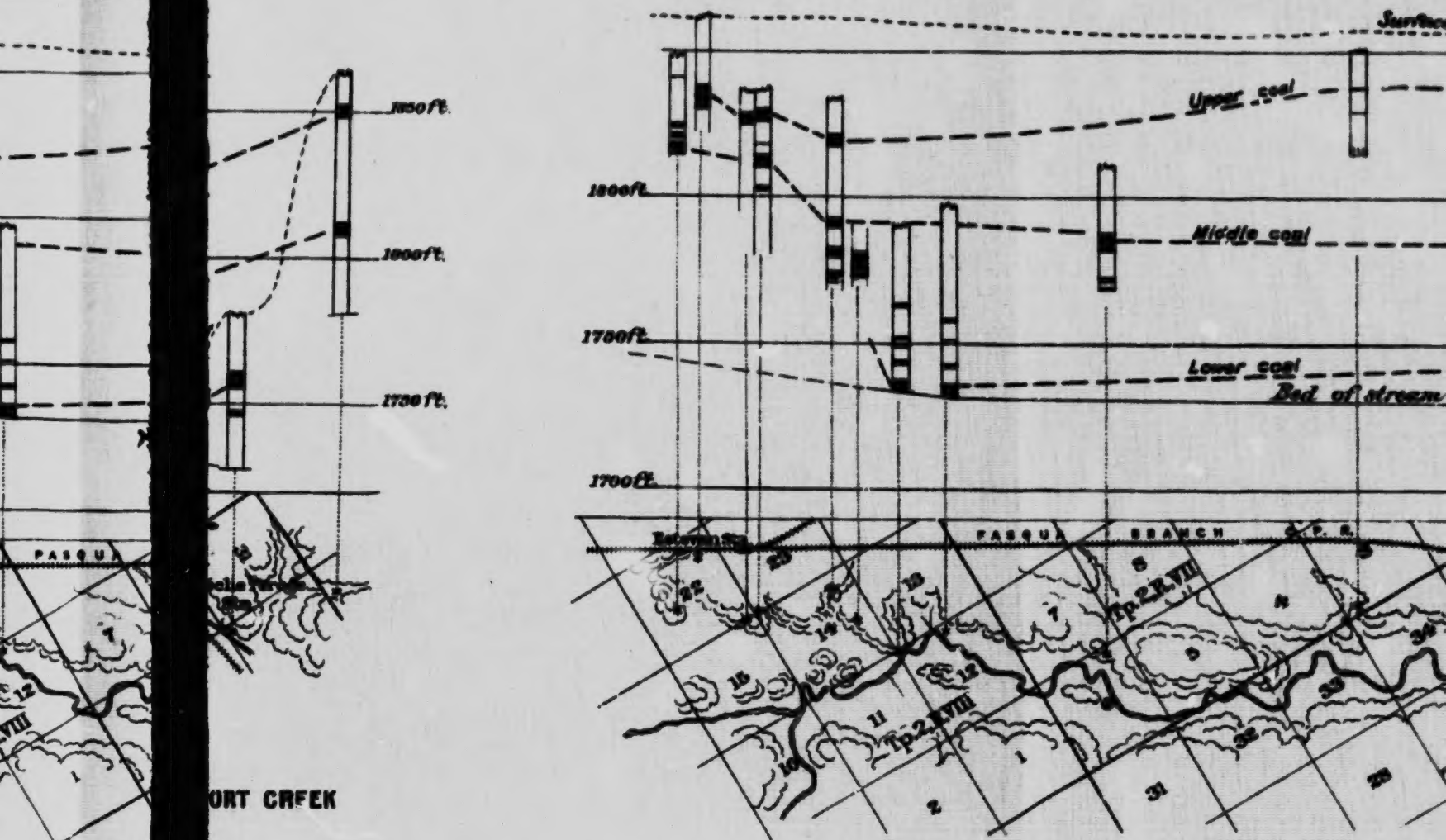


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ROBERT BELL, Sc.D., (Contd.) LL.D., MD., FRS, ACTING DIRECTOR

INDS

**SECTION ON NORTH BANK SOURIS RIVER
FROM ESTEVAN TO ROCHE PERCÉE**

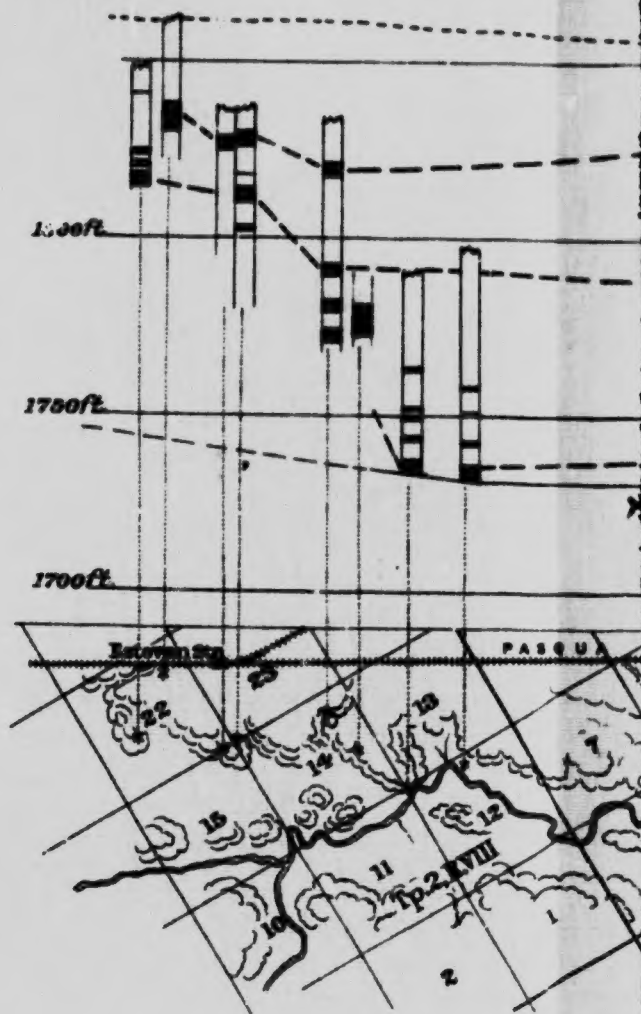
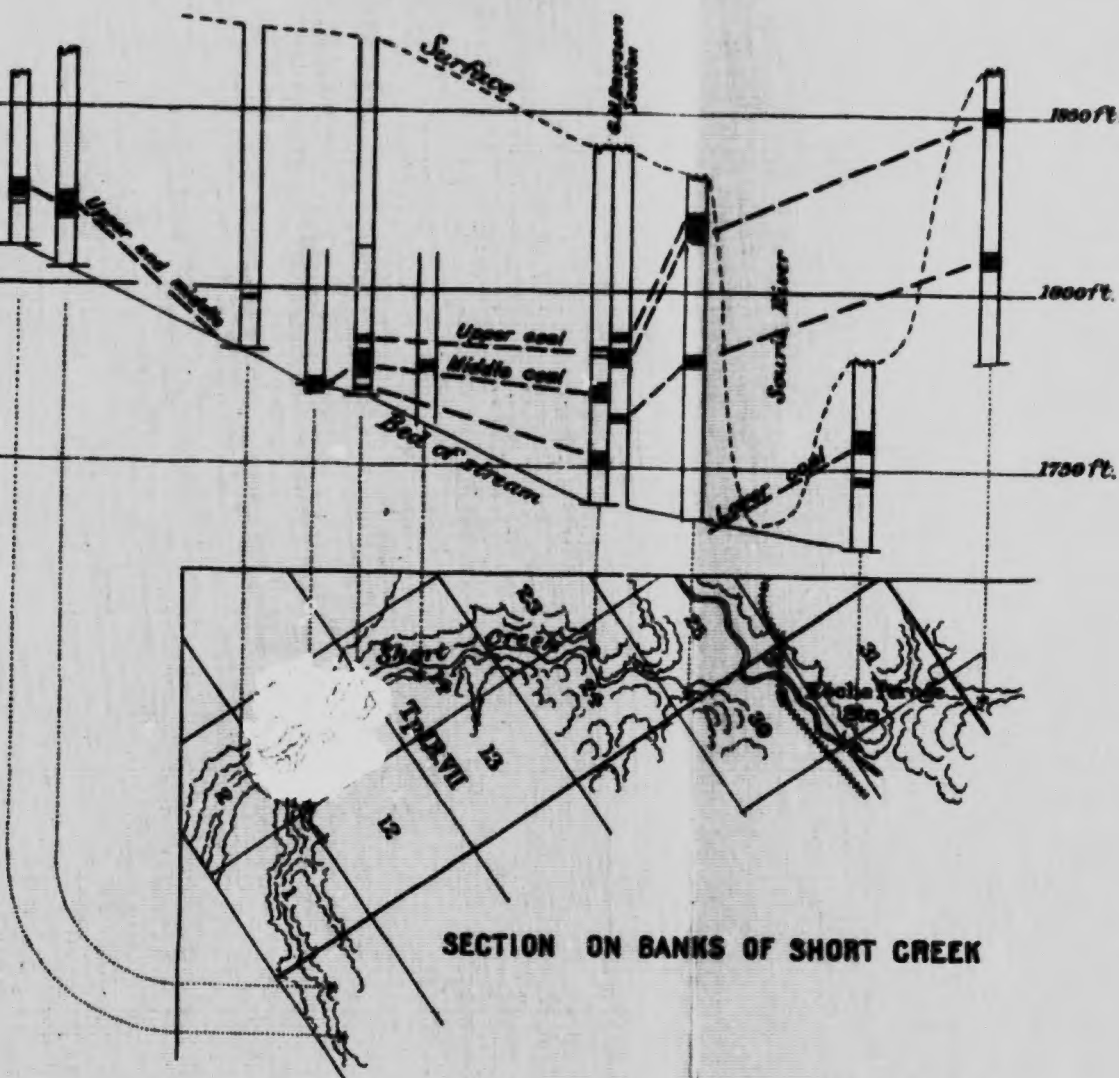
ONS OF THE SOURIS COAL-FIELD, DISTRICT OF ASSINIBOIA.

To accompany Report of
D. H. DOWLING, B.A.Sc.

Geological Survey of Canada

ROBERT BELL, Sc. D., (Canada) LL.D., MD., F.R.S., ACTING DIRECTOR.

1893.



Scale 0 1 2 Miles

SECTIONS OF THE SOURIS COAL-FIELD, DISTRICT OF ASSINIBOIA.

To accompany Report of

D. B. DOWLING, B.A.Sc.



MAP OF THE

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THE

GEOLOGICAL SURVEY OF CANADA
ROBERT BELL, Sc.D. (CANTAB.), M.D., LL.D., F.R.S., I.S.O.

REPORT
ON THE
COAL FIELD OF THE SOURIS RIVER
EASTERN ASSINIBOIA

BY
D. B. DOWLING, B.Ap.Sc.



OTTAWA
PRINTED BY S. E. DAWSON, PRINTER TO THE KING'S MOST
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MAR

To Dr. ROBERT BELL,

Acting Director, Geological Survey of Canada.

SIR,—I have the honour to submit the inclosed report on investigations conducted during part of the summer of 1902 in the Coal Field of the Souris river. To illustrate the report, I have made to scale a model showing the surface features of the region from Estevan eastward to a point beyond the coal mines, and photographs of this are submitted for reproduction. A few photographs of natural features and sections also accompany this report, as well as sections plotted to show the probable trend of the different coal seams.

I have the honour to be, Sir,

Your obedient servant,

D. B. DOWLING.

Ottawa, April 29, 1903.

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REPORT
ON THE
COAL FIELD OF THE SOURIS RIVER
EASTERN ASSINIBOIA

By D. B. DOWLING.

GENERAL FEATURES OF SOURIS COAL FIELD.

The actual area over which the coal-bearing rocks of this district extend, is not exactly known, principally because there are so few exposures in the stream valleys, on account of an extra thickness of surface deposits, eastward from the area now mined. This great mantle of drift consisting of boulder-clay extends northward through the Moose mountains and is continued north of the Assiniboine river. It has concealed the eastern outcrop of the coal rocks and their extension can be learned only by boring. At Oxbow a deep well for the water-supply of the town had penetrated sandstone at 230 feet below the surface and small particles of coaly matter came up in the overflow pipe. This indicates their eastward extension to at least the mouth of Moose Mountain creek. The lower land between that creek and Turtle mountain is probably eroded to beneath this horizon. Westward it is supposed that the Tertiary coal-bearing rocks extend to the Coteau and also occupy the summit of Wood mountain.

Along the face of the Coteau extends a wide flat which is drained at present both to the northwest and southeast by parallel streams which appear to have a very slight fall. Moosejaw creek heads in the Yellowgrass marsh near the head also of the Souris river. The elevation of the surface at the nearest railway station, 1889 feet, is not very much above that at Estevan or Pasqua, so that this strip may be said to be a nearly level plain bordered on both sides by a slight rise. The only deep river valley cutting into this is that of the Souris river and its main branch Long creek. From the north

Drainage.

the drainage has as yet cut only a short valley from the Qu'Appelle to near Moose Jaw with a fall in that distance of 135 feet. This northward drainage seems therefore to be much more recent than that to the south and suggests that the drainage area of the Souris has been reduced by a later tilting of the plain by a slight depression to the north. Evidence of the late depression is more pronounced in the western part of the plains in Alberta, but on the other hand in Manitoba the latest crustal movement is an elevation to the north, so that in this area the movement has been slight in either direction and, as noted above, probably the northern part has been slightly depressed.

Denudation
of valleys

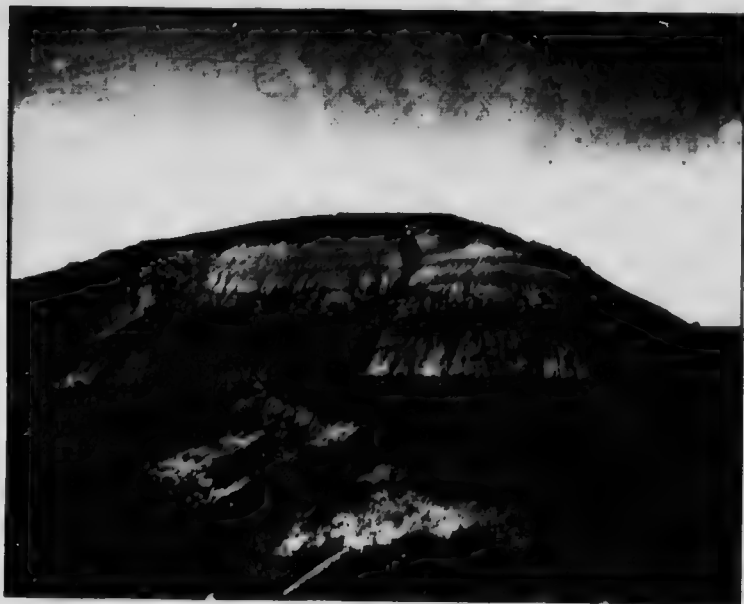
The main valley of the old drainage is now occupied by Long creek as shown on the maps, but a slight depression just to the east of the Coteau carries another stream which joins the large valley opposite Estevan. This carries about the same or even less water than Long creek and is called Souris, although it would seem that the other should have had the name. This part of the Souris has cut a very narrow and short valley above its junction with the large one at Estevan. Evidence of the very level nature of the surface drained is seen in the shifting of the channel which led from the edge of the plain into the valley, causing a series of parallel lateral valleys on the north side above Roche Percée. Many of these lateral gorges were eroded by companion streams which have gradually lost their water supply by the deepening of the channel of the main stream. Several small isolated hills in the valley remain to show the former continuance of the side walls of these companion valleys.

Side gullies.

South of the Souris and east of Short creek there is a decided rise in the surface amounting to about 100 feet above the general prairie level. From this to the bed of the river there is a fall of 240 feet in a distance of only two miles and as the rocks underlying the surface are very friable they are easily eroded and the drainage of this slope has excavated a number of very large and wide gullies which have dissected a broad area. On the north side the banks below Roche Percée are high and where the lower coal seam is being mined are intersected by narrow steep cuts which are taken advantage of in getting at the seam.

Width and
depth of
valley.

South of Estevan the valley is wide and is in fact a double valley, about a mile and a half wide and 110 feet deep. At the mines it is less than a mile in width and over 130 feet in depth. The river-flat is well grassed and a fringe of trees skirts the stream. Many ox-bow lakes show the gradual shifting of the channel by cutting off bends.



D. B. D., photo. 1902.
NATURAL EXPOSURE CLAYS AND SANDS JUST ABOVE LOWER COALS ON SEC. 13, TP. 2, R. 8.



D. B. D., photo. 1902.
WEATHERED SANDSTONE, SEC. 13, TP. 2, R. 8.

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THE COAL HORIZONS.

The coal seams exposed in the district are many but in the small area here described they may be grouped in three horizons—Upper, Middle and Lower. Each of these may contain several seams but in each, workable seams occur at places.

Upper Horizon.

This contains generally a four feet seam that is fairly continuous Upper seams. throughout the district except where eroded away by the streams or, as on Short creek, where it either thins out or is joined by the seams of the middle horizon to form a seven feet seam. The coal seams are separated by deposits of sand and clay that are very variable in their thickness and areal distribution—measures that are prominent in some sections being absent in others so that a series of small seams may, by the absence of these partings, be brought into one. The upper horizon has been prospected in the vicinity of Estevan at several points and though the coal is generally an inferior lignite it serves for local use. The first mine opened in the district was on this upper seam, locally thickened to eight feet or thereabouts. On the hillside just south of the town, several thin seams are exposed, probably of the upper and middle horizons, but they are very poor and only a part of each seam is utilized. Another opening on this seam is on the edge of a ravine near the cemetery where a tunnel shows the thickness to be about four feet. No other exposure of this horizon was noted for some distance to the eastward and it is again well exposed in a ravine north of the Taylor mine. It has there been mined in several places and being near the prairie-level the coal was easily teamed northward to some of the stations on the railway. Above the Souris and Roche Percée mines it is still in evidence and is opened in several places. On Sec. 35 it was reached in the bore-hole at about 50 feet from the surface but is somewhat lower in the exposure near the river. A tunnel on Sec. 6, of the township to the east, is on the same seam at a higher level than in the bore-hole. The sections accompanying this report are drawn to scale so that the position of the seams can be measured, but as a rule the absolute heights are given in the text along with the descriptions of the sections. In referring to the sections it will be seen that along the north side of the river the upper coal is probably continued at a distance from the immediate brink of the valley and may undulate slightly. Near the eastern end of the field there seems to be a very pronounced wave in the beds below, and probably the upper seam follows the same curve. The

North bank of river.

sections across the large valley and up the smaller ones i.e. from the Taylor mine up Short creek, and from the Soo mine up the Souris, show firstly that on Short creek there is a depression to the south whereby the upper and middle seams are brought together and secondly that on the upper part of the Souris the upper seam rises slightly to the south.

Middle Horizon.

North side of
river.

Along the north side of the valley this horizon is found to be exposed in several places but shows a great tendency to thin out in places and east of the mines it is hardly discernible. The isolated hill west of Estevan, in which a tunnel has been run is probably a representative of this horizon. There the coal is split up into three seams—the lower one only being mined. Again on the face of the hill south of the town a four feet seam slightly lower in elevation is its probable representative. Above the Soo mine a three feet seam of coal and shale at 1790 feet is probably of the middle horizon. Farther east it is doubtful whether the seam in the Duncan mine belongs to this or the lower horizon and may be the burnt seam that is exposed at the top of the bank in the south-east corner of Sec. 14. A seam that was on fire in the north east corner of Sec. 6 of the next township to the east may belong to the middle group. A valley to the north of this would deflect the outcrop to the north leaving a long oblong hill with a portion of this coal near its top. Burnt shales indicate feebly its presence along the bank to near the mouth of Short creek. An exposure at one of the bends of the river shows four feet of burnt shale, indicating a burnt seam of fair thickness and as it is about at the proper elevation for this horizon it is so marked on the section. In the ravine north of the Taylor mine at an elevation of 1807 feet there has been a tunnel driven on a 3 ft. 6 in. seam which is below the upper coal 'at eastward from this the seam becomes insignificant and split up by partings. In the Hassard mine there is a two feet seam at this horizon, but this, is represented in the Sugar Loaf section, by two seams of a foot each, separated by a foot of gray clay. No trace of lignite is found farther east on the north bank.

In the southward bend of the upper part of the Souris, the middle seam takes a prominent place and is found well up the bank near the larger valley with a thickness of six feet. Good exposures are rare in this part but it is found near Wood End in a seven feet seam and the percentage of fixed carbon left by fast cooking shows that it is of as good quality there as the average of the coals of the valley. On Short creek, as before mentioned, there is a thinning out of the measures

between the middle and upper coals and they seem to come together. Several short tunnels have been run into the banks to extract coal from this seam and apparently the supply has been required by settlers of the immediate vicinity and across the boundary line. There is a slight rise in the measure to the east so as to bring up the seam again on the east branch of this creek in Sec. 6 near the International boundary.

Lower Horizon.

This is the most important in the district, as in it the lower seams are of better quality as a rule than any in the upper horizons. In the western end of the district there are several small seams, occasionally of workable thickness but east of the mouth of Short creek these are gathered together in an eight feet seam that is being mined on a much larger scale than near Estevan. West of the mouth of Short creek the outcrop of the seams is low down in the valley and most of it would be below the river flat, but it is probable that it has been eroded close to the sides of the valley and the river flat filled with river deposit. The dip of the seams in this lower horizon is not very constant in any direction. The section shows a considerable wave at the east end on the north side of the valley with a general tendency to become lower to the west. South from the mines the outcrop seems to be below its position on the north and this southward dip is further proved in a boring on Sec. 10, in which the seam is found at 20 feet above its position in the bore on Sec. 35. This may however only mean that the crown of the anticline in the seam at the Souris and Roche Percée mines is continued in a N.N.E. direction. This if produced southward will pass through Sec. 5 near the boundary and bring up the middle and upper seams that go below the valley-bottom at the conical hill at the mouth of the east branch.

In the upper part of the valley, south from Estevan, the lower horizon rises slightly and is found higher up the river than expected. In the bed of the stream on Sec. 22 the lower coal was seen for the last time in that direction. Near Estevan exposures of the lowest part of this horizon are seen on the south border of Sec. 14. Up the valley toward the town the measures rise slightly and beds, probably of this horizon, are found low down in the banks as at the Soo mine. On the south side of the valley a mine is opened in the south-east corner of Sec. 11 on two seams of five and six feet thickness that are somewhat higher above the river-bed than those of the same horizon northward, but in the sec on given on Sec. 10 it is found again split up into several small ones.

South side of
river.

Very few exposures were seen between the bend of the Souris and the mouth of Short creek, but interested parties who have probably sunk test pits report that there are several valuable seams at accessible locations in this part of the valley. A mile west of the mouth of Short creek on Sec. 35 there is an exposure of a five foot seam near the water of the creek. This is not all pure lignite as the lower part is very dirty, but a short distance to the east it is split up into two seams—the lower, two feet three inches thick, being of a very fair quality of lignite which on coking leaves 38.90 per cent of fixed carbon.

At the mines.

The other exposures that occur east of this are those only that are at the mines. In the Taylor mine the seam is five feet with a small seam below. In the Hassard the parting gradually thins out towards the east, and across the ravine in the New Souris mine there is a thickness of eight feet of lignite. In the workings this occasionally thickens up to a maximum of twelve feet for short distances. In the Roche Percée mine the seam is about eight feet and in the bore-hole on Sec. 35 there were seven feet six inches. East of this no trace of the lower coal has been found by the miners. At one locality on the south side of the river on Sec. 28, at the mouth of a gully, the lower seam was found and some coal was extracted, but as it was low down it is probable that the water interfered with the workings.

Lowest seam.

In the bore-hole put down by Dr. Selwyn on the side of the valley in Sec. 6 he probably did not strike any of these, but was able to demonstrate that there is yet another seam much lower down in the series, that may by the undulations of the beds be found nearer the surface in places to the north and on the river eastward, that have been generally considered nonproductive.

Burning of Coal seams.

Burning of
seam.

Enquiries made at the mines have elicited the information that in the vicinity, the burning of the seams extends at farthest only about one hundred feet, back from the bank. The cause of the seams catching fire at the surface can generally be traced to the drying out and disintegrating of the lignite at the outcrop rendering it easily kindled. The ignited mass slowly extends farther into the bank drying by its heat the upper part of the seam which is first consumed as far back as the lack of moisture allows. The further consumption of the lower part proceeds very slowly before it is extinguished.

Mines operating.

During the summer many of the mines are not in operation as the market for the product of smaller ones is purely local and the demand only for the winter months. In the Estevan district there was only one (the Duncan mine) that was shipping coal by car lots. This was drawn by team to a spur or siding on the bank above. The mine is not developed to any extent, as yet only four rooms, two on each side of the entrance, being mined out and the timbering required is not very extensive. Of the Soo mine, which is said to be worked in the winter, no information as to the character of the workings could be obtained as the slope was flooded with water. Many open cuts along the side hill are to be seen near the town where farmers have dug up coal for home use. Across the valley on Sec. 11 a tunnel is driven into the bank on a six feet seam and a slope farther in leads down to a lower seam, said to be five feet thick. As the tunnel was not well timbered part of the roof had fallen and the interior was not seen. About two miles up the Souris from the bend, a tunnel is being dug into the hill on the west side of the valley, probably on the middle seam.

Prospect tunnels.

The Souris Coal Co., which now has control of the mines working at Coal Field east of Roche Percée, has for the present closed up the Taylor mine near the latter station and confined its operations to the group known as the Hassard, New Souris Farmer and the Roche Percée mines. These are all on an eight foot seam. The entrance to the Hassard is from the west side of the gully on the southern part of Sec. 4. As the seam has an easy slope to the west, the entrance is on a slight incline and the drainage of the mine is accomplished by a steam plant which also compresses air for the cutting machines. In the New Souris mine the entrance is to the east and just opposite the Hassard. In this the seam is reached by a short slope and as it rises slightly toward the north-east the loaded cars require very little power to haul them to the foot of the slope. The drainage is very simple and might be said to be natural. In the Roche Percée mine the entrance is from the level and the seam for a short distance, rises slightly and then runs on nearly a level, with perhaps a slight fall to the north east. The drainage is principally by a siphon to the mouth but an adit-level has been cut eastward to the next gully.

Mines at Coal Field P. O.

The system of mining is generally by the room and pillar method. Double entries from the foot of the slope or from near the entrance are driven with a width of about six feet, leaving a pillar of at least twenty feet between them. Side entries run from the main ones and

System of mining.

from these the rooms are opened about twenty feet wide with a pillar of the same width.

Ventilation. The ventilation is induced by chimneys opening to the surface of the prairie above, in which a fire is kept burning and the circulation of air is controlled by a system of doors on the entries and small tunnels from these to the rooms.

Timbering. Timbering in the entries is made close, but in the rooms it is found that a double row of posts at six feet apart is sufficient, the roof though generally of soft sandstone does not fall suddenly and often a thin roof of coal is left, as it is brittle and by cracking warns the miner. In parts of the mines where the seam is very wet, the entries are extended so as to cut out large areas and the block is allowed a season to drain out.

Amount and character of coal.

Character. As the coal is a lignite, its physical condition renders it difficult to transport without loss from both slacking and crushing. Its chemical composition shows not only a high percentage of water but also of volatile combustible matter. The water is readily lost to a large extent by exposure to the air so that it is generally shipped in closed box cars and care is also taken in storing it in a closed shed. The loss of the moisture causes it to crack and the poorer part is reduced to powder.

Amount of coal. In the mining the friable nature of this coal causes also a large loss by waste in the process, so that instead of a cubic content of twenty-five feet making a ton it is more generally found that at least thirty feet are necessary and in parts of a seam a higher percentage of loss ensues. If the miner could extract all the coal in the mine at even this percentage of loss there would still be for this eight feet seam a total of 10,890 tons to the square acre or for the square mile 6,969,600 tons. This amount is all that can be expected from the one seam, but for local use there are several seams as outlined previously, above the one at present being mined and the total supply can thus be greatly added to.

Lignites of plains. In a general way the lignites of the plains, in beds not disturbed by lateral pressure or folding, are very similar, but it is found by analysis that the percentage of fixed carbon decreases eastward from the mountains. A few examples are here tabulated to show the fairly general tendency. The samples are from natural exposures.

- 1 Turtle mountain, Dakota, fixed carbon 36.90 Bull. U.S. Geo. Surv. No. 27 p. 74.
- 2 Souris river, Sutherlands tunnel, carbon 38.64 Report of Pro. 1882-83 84 11m.

- 3 Hay flat, Wood mountain, carbon 38.54. Annual Report 1885 3m.
- 4 Main seam, Mine 7 miles W. of Medicine Hat, carbon 41.58. Annual Rep. 1885 1m.
- 5 Coal banks, near Lethbridge, carbon 47.91. Report of Progress 1882-83-84 30m.
- 6 North edge of Milk river ridge near Fossil coulee, carbon 49.85. Ann. Rep. 1885 5m.
- 7 North fork of Old Man river at base of Rocky mountains, carbon 58.40. Report of Progress 1882-83-84 33m.
- 8 South fork of Old Man river, carbon 57.50. Annual Report 1885 9m.
- 9 Cascade mine, Bow river, carbon 74.35. Report of Progress 1882-83-84 41m.

Nos. 7, 8 and 9 are true coals—the last one being a semi-anthracite.

In a general way the lower seams or those having a greater thickness of strata above them are better in character than those nearer the surface. This is shown in several analyses made by Dr. Dawson of the seams exposed on Sec. 10, south of Estevan, and given in paragraph 210 in the International boundary report. The members of the section are numbered from the top downward.

Increase of
carbon with
depth below
surface.

No. 2 is a lignite having 30.10 per cent of fixed carbon.

No. 10 is a lignite having 36.68 per cent of fixed carbon.

No. 17. A weathered specimen (percentage low) 28.01.

No. 19. Lignite (weathered) 38.35 per cent fixed carbon.

In following the seam, given above as No. 2, up the valley to the south, it becomes covered by a greater thickness of strata and near Wood End an analysis shows 34.97 per cent fixed carbon. Many of the seams show a tendency to change in character—sometimes indeed passing into a dark shale with hardly a trace of carbon.

Age of the deposits.

From the fossil remains collected at different times from this locality, it has been generally recognized that these beds are directly comparable with the Fort Union group. In the Edmonton district of northern Alberta, the beds which were referred to the Laramie are divided into two series, the lower deposited in brackish water and the upper in fresh water. The upper series, the Paskapoo, contains a fauna that is certainly very similar to that found in the Souris and may therefore be correlated with it. The Souris rocks are thus probably situated at the base of the Tertiary and above the upper part of the transition series at the top of the Cretaceous.

Age of
deposits.

The division drawn between the upper and lower parts of the Laramie probably comes below the coal seams of the district, and the lower part comparable to the Edmonton beds is to be found in the section given in the bore-hole put down by Dr. Selwyn east of the mines. The coal

horizon reached by this bore at about 300 feet, probably represents that which is repeated in the lower slopes of Turtle mountain in Manitoba and again to the west in the western part of the Coteau and the Wood mountains.

This would show a wide shallow syncline along the International boundary, the centre of which, showing the highest beds, being in the neighborhood of the mines at Roche Percée—the high plateau east of Short creek and the eastern part of the Coteau.

Fossils.

The horizon at which most of the fossils were found is above the lower coal seams which are here exposed and many of them come from the beds between the upper and middle horizons. The plants are from the shales above the lower coal.

The following forms are compiled from the lists already published :

Unio priscus, M. and H.
Corbula mactriiformis, M. and H.
Thaumastus limnariiformis M. and H.
Goniobasis Nebrascensis, M. and H.
Goniobasis tenuicarinata, M. and H.
Campeloma productum, White.
Campeloma multilineatum, M. and H.
Viviparus trochiformis, M. and H.
Viviparus Leai, M. and H.
Viviparus Conradi?

PLANTS.

Platanus heterophyllus, Newberry
Platanus nobilis, Newberry.
Sassafras Selwyni, Dawson.
Quercus. Sp.
Taxites Olriki, Heer.
Taxites occidentalis, Newberry.

Beside the above we made a collection of plants which are not yet determined, as well as a small collection, mainly the same forms as in the above list ; and from just above the lower coal a claw of a turtle and a vertebra, probably of a reptile of the type of *Champsosaurus* were obtained.



D. B. D., photo.

THE SUGAR LOAF HILL, SOURIS MINES.

1902.



D. B. D., photo.

WEATHERED SANDSTONE, SOUTH SIDE OF SOURIS VALLEY.

1902.

NATURAL EXPOSURES AND SECTIONS

North side of valley from Estevan eastward.

Just west of the station yard at Estevan, the railway crosses a deep gully running west to the valley of the Souris. In this the first extensive work of extracting coal was begun in what was called the old Dominion mine. This was on the upper seam, which is generally found to be about four feet in thickness over a large part of this area. Here however it had a thickness of about eight feet but the quality proving poor the enterprise was abandoned. As the old workings are blocked up the only exposures now to be seen are in a small tunnel about one hundred yards west of the trestle, running into the south bank. Here the seam is eight feet but very dirty looking—a bright part about ten inches thick near the top being the only good coal in the section. On the northern side of the gully the old entrances to the levels of the Dominion mine still stand though the railway tracks that formed a spur down the coulee have been removed. From all appearances the seam worked was of a friable nature and very dusty. It is only about twenty feet below the surface in the vicinity of the town. The elevation by comparison with the rails at the station is 1830 to 1838 feet above tide.

Dominion
mine.

In the valley to the south this seam is not well exposed as the slopes are mainly grass covered. On the slopes of an isolated hill almost south of the old mine several of the upper seams are well exposed. The upper four foot seam is represented by a few streaks of lignite. Below this the middle seams, which along the valley are generally burnt at the outcrop, are here represented by quite important beds. The section in the hill is given below.

Section in
valley west
of Estevan.

	Feet in.	Approx. Elevation.
Clay	6 0	Top of hill 1847
Lignite thin streaks		1841
Clay	16 0	Top of coal 1825
Lignite	1 6	
Clay	2 6	
Lignite	1 0	
Clay	2 0	
Lignite	3 6	
		Bottom of section 1814

Near the north end of this, another level has been excavated into the hill to strike the same bed but it had been burnt out.

Coal seams
beneath
Estevan.

On the edge of the bank south of Estevan station and near the post marking the conjunction of the four sections numbered 14, 15, 22 and 23, a ravine cuts into the bank for a short distance leaving a projecting point in section 15. On both sides of this point the upper and middle coal seams are exposed. On the west side the upper seam has been opened along its outcrop and considerable coal taken out without mining. Here the elevation of the seam is 1825 feet above sea. The seam, probably the one at the Dominion mine, contains only 17 inches of fair coal covered by two feet of carbonaceous shale almost a lignite.

On the eastern edge of this point the same seam is again exposed with a covering of light clay six feet in thickness to the top of the bank. Below there is grey clay for eight feet to the top of another small seam. Yellow sandy clay with ironstone nodules occurs at the bottom of this exposure below the last coal seam. South of this section and above the road leading down from the town, at 1810 feet or 16 feet below the upper seam there is an exposure of four feet of poor dusty lignite of which only the lowest foot appears to be fairly hard. Grey clay five feet in thickness lies below this and then another small lignite seam is seen. The beds beneath the road leading out of the coulee ought to be on the horizon of the seams at the Soo mine in the next ravine to the east.

The section here can be summarized as below :—

	Feet	in.	Approx. Elevation.
Light grey clay.....	6	0	Top of bank 1836
Lignite.....	4	0	Base of seam 1826
Grey clay.....	8	0	
Thin seam of lignite.....		1	 1818
Yellow clay and sand.....	4	0	
Lignite.....	4	0	Base of seam 1810
Grey clay.....	5	0	
Measures concealed.....	2	0	
Lignite 1 ft quarried.....	1	0	Concealed to foot of slope 1780

Sec. 14, Tp. 2,
R. S.

The north east quarter of Sec. 14 is cut up by a large coulee opening southward at the centre of the section. The exposures in this show the heaviest coal horizon to be at about the lowest part or floor of the area thus eroded. On the outer edge of the banks as they approach the river valley there appears to be a slight dip to the south-west so as to carry the coal seams beneath the river flat. This may mean, however, that the coal is burnt out along the edge of the valley and into the banks to the north, so letting down the top measures five or six feet. On the north side of the amphitheatre here formed is the

Soo mine. A sloping tunnel leads down from the foot of a scarped bank and coal has been mined here by Mr. Yardley. Nearer the railway, in a narrow valley, an upper seam has been opened by prospect holes near the surface. It has there a thickness of $4\frac{1}{2}$ feet but it is soft and dusty and would not bear much transshipment.

The section here is as follows:

	Feet.	in.	Approx. Elevation
Grassy slope, measures concealed.....	11	0	Top of hill 1833
Lignite, seam exposed in ravine.....	4	0	Base of seam 1817½
Gray clay with sandy streaks of lignite.....	11	0	
Gray clay.....	5	6	
Yellow streak.....			
Gray and yellow sandy clay.....	6	0	
Ironstone nodules.....			
Gray clay.....	2	0	
Lignite and shale.....	3	0	
Sandstone.....	7	6	
Clay ironstone layer.....			
Lignite.....	1	6	
Black shale.....		8	
Lignite.....		10	
Clay and sand.....	4	6	
Lignite, seam being mined by Mr. Yardley.....	3	6	Top of coal 1775

In the next side gully east from the Soo mine, probably on the northern part of the south-west quarter of Sec. 14, an opening has been made at nearly the same level as at the Soo mine, by Mr. P. Duncan. Here the partings between the three lower seams have disappeared and nearly eight feet of coal is being mined. The slope extends into the hill about two chains, and two rooms have been extended back about forty feet from the tunnel on each side. The face of the seam shows a fair quality of lignite, with a dull portion in the centre—the lower part being of better quality. A roof of more than a foot of the coal is left and about six feet and a half is taken out. This is being shipped in car lots—the transfer from the mine being made by team to a spur on the railway above the mine.

The top of the coal seam is at about 1781 feet above sea or nearly on a level with the top of the three lower seams at the Soo mine.

The south-west quarter of Sec. 14 is homesteaded by Mr. M. Carroll and is mostly a broad river flat. In the southern part two isolated hills are being cut into by the stream along their south side and three seams are exposed. The lower one is of fair coal about four feet

in thickness and it has been mined to some extent. The rising floods almost reach the mouth of the tunnel but it is generally about 15 feet above the stream. Above this four foot seam there appears to be a lignite of fair average quality, the section shows 1 foot of yellow sandy clay followed by 18 inches of poorer lignite. A variable amount from 28 in. to 24 in. of light clay showing sections of stems and pieces of carbonized wood is above the middle seam and a thickness of 14 in. of poor coal represents the upper part of this coal horizon. In tracing this upper seam around the hill it appears to thin out considerably. Above the coal is five feet of clay, at the top of which is a clay ironstone layer. The ironstone is found at the eastern end of the hill at two feet above the coal so that the intervening clay deposit is very variable in thickness. The ironstone is covered by clays and sands to the top of the hill, about 25 feet.

Southern
corner of
sections 13-14.

The river makes a strong bend to the east and touches the south-west part of Section 13. A high point at the extreme south-west corner is scarped and shows a section of nearly 57 feet. The faint exposures along the banks from Estevan eastward would seem to indicate that the same beds were exposed all along. If the coal seams found here are the same as at the Soo mine, there must be a slight dip to the east amounting to forty feet from the mine to the south-eastern corner of the same section which will be seen on a comparison of the elevation given for the two sections. The section at this place is given below in descending order.

	Elevation.	
	Ft.	in.
Top of exposure	1791	0
Yellow sandstone overlying burnt shale, beneath which is a series of sands arranged in bands yellow and grey	27	0
Lignite	1	0
Clay light grey	3	6
Ironstone band		
Sandy clay	6	6
Clay ironstone		
Clay and ironstone	9	
Lignite	1	0
Clay	1	0
Lignite one foot to fifteen inches	1	3
Sandy clay	4	6
Top of coal seam	1744	6
Lignite	1	6
Covered to water	8	6
Estimated level of water in river	1734	0

In the lower part, now concealed by a landslide, there is evidence to show that coal has been mined here, but the spring freshets flood the workings and drag down more of the cliff. It is reported that the farmers open up a four-foot seam that comes above the water-level at that season each winter. It is probably a seam which is partly covered by the present stream in flood.

Strata on the north part of Sec. 12 just south of the half mile mound, Sec. 12, Tp. 2, R. 8, in descending order :

	Elevation.	
	Ft.	in. Ft.
Top of section	1797	
Grey clay and rusty pebbles	20	08
Yellow clay with a streak of ironstone no tubes at bottom	20	0
Dark carbonaceous shale	1	0
Grey clay	6	0
Clay ironstone band		
Lignite	6	
Measures concealed	8	0
Lignite	1	0
White sandstones	5	9
Lignite, thickness unknown		
Slope covered to water	6	3
Level of river	1730	

A grass-covered valley with steep slope runs parallel to the river. This depression extends from Sec. 33 to the town of Estevan and thus forms a narrow ridge between it and the river. Side valleys cutting directly back from the river have begun the gradual dissection of the ridge into long hills, a process which can be seen at a later stage in the lines of small ridges in the larger valley.

Exposures are not frequent along this part but a small section is shown in a hill in the north east part of Sec. 6, township 2, range 7, where one of the side gullies is cutting across the narrow ridge.

	Elevation.	
	Ft.	in. Ft.
Top of exposure	1810	
Yellow sandstone		
Top of coal seam on fire	1788	
Lignite approximate thickness	6	0

A small conical hill just here has had the coal seam which formed its top burned away. Below this a clay ironstone band appears at 1775 feet.

The section under it is :

		Elevation.	
		Ft.	in.
Sec. 6, Tp. 2, R. 7.	Top of clay ironstone.....	1775	
	Gray clay with yellow streaks.....	2	0
	Poor Lignite and black shale.....	1	0
	Sand.....	1	0
	Black shale.....	2	0
	Bottom of exposure.....	1769	

Section on river bank in Sec. 5, township 2, range 7 :

Directly south from the centre of the section on the river bank a small exposure shows three small seams near the water. At 1803 feet, the top of the exposure, yellow sands and clays with a few beds hardened into sandstone form the mass of the upper 30 feet. At 1773 feet or 30 feet down, a broad red band shows where the coal seam noted a mile up the river as being on fire, has been burned out. Gray clays show to 1742 feet or 12 feet above the water, underlaid by three small coal seams.

Sec. 3, Tp. 2,
R. 7. Section on south-west corner, Sec. 3, township 2, range 7.

Beds altogether above those exposed in the last section are here seen and the horizon of the upper coal should be exposed. It may probably be represented by two thin seams in the upper part of the section.

		Approx.	
		Feet	in.
Prairie level.....		1850	
Clay and small fragments of ironstone.....		5	0
Gray clay.....		6	0
Black carbonaceous shale.....		0	3
Brown shale partly lignite.....		1	0
Light yellow sandy clay.....		6	
Bright yellow to orange sandy clay partly sandstone.....		9	0
Lignite.....		0	2
Brown and gray clay.....		4	0
Yellow sandstone and clay-ironstone.....		3	0
Gray clay.....		2	6
Yellow clay-ironstone and thin bedded clays.....		2	0
Whitish gray sandstone.....		2	0
Base of exposure.....		1815	
		34	4

Exposure on south-east part of Sec. 35, township 1, range 7.

The upper beds of the exposure given above are not repeated between this and Roche Percée as the banks are much too low near the river

and the outcrop would probably follow north of the township line. A dry valley parallel to the present one affords an easy grade for the railway out of the valley on the north side. The point thus cut off is not as high as the average of the banks elsewhere. A bend of the river cutting into it affords a good exposure of the lower beds. The top of the exposure commences near the base of the one above and may include some of it. The following is the section in descending order:—

	Feet	m.	Approx. elevation, about, 1817
Surface			
Boulder clay and surface deposit	2	0	
Brown sandstone	2	0	
Gray clay	8	0	
Sandstone	6	0	
Clay with shells	12	0	
Red burnt shale	4	0	
Supposed lignite seam			1783
Yellow and blue clay	6	0	
Gray sandy shale	2	0	
Yellow sandstone	3	0	
Gray sandstones with dark clay at top	6	0	
Gray clay with streak of lignite at top	4	0	
Sandstone	2	0	
Gray clay, red streak at top	9	0	
Dark gray clay, brown at top	6	0	
Lignite much weathered, with streaks of clay near base	5	0	
Concealed to water of stream	10	0	1730
	87	6	

The burned seam at 1783 appears at the right elevation for a continuation of the seam noted as being on fire in Sec. 6, about four miles to the west. It is impossible to be certain without sections closer-together international but the beds seem to be undisturbed. The exposure are continued along the bank to Sec. 25. The references to these in the International boundary report are in the following paragraph:—

207 sections more or less perfect are exhibited in many places in the Souris valley, a mile or two west of the entrance into it, from the south, of Short creek; and more especially on the north side of the valley. They show a great similarity, though not absolutely the same in any two places.

One of the most perfect exposures seen was in the face of a bank from sixty to seventy feet high, and consisted of sand, sandy clays, and hard fine clays very regularly and perfectly stratified, and coloured in various shades of yellow-gray, gray, and light drab. At two differ-

ent levels harder sandstone layers of small thickness were seen and also three distinct beds of lignite.

The lowest is a hard compact lignite resembling cannel coal in aspect, and two feet three inches thick. A few feet above this a second seam, eighteen inches thick, occurs, and still higher in the series, and about half way up the bank, a third, of the same thickness. At the top of the bank some large nearly spherical nodules rest, and have evidently been derived from a superior bed which has been removed by denudation. The clays and arenaceous shales, at several different levels include remains of mollusca, but these are very fragmentary, having been crushed by the compression of the containing material. A species of *Unio* is abundant, and remains of gasteropoda also occur, though rarely, and in poor preservation."

Sec. 31, Twp. 1. Eastward and north of Roche Percée station the exposures are not
R. 6. very distinct but the coal seams of the lower horizon appear to rise slightly and at the Taylor mine in the south-east corner of Sec. 31, township 1, range 6, a thickness of five feet of good lignite is mined. 28 feet above the water of the stream. Above the coal is a well defined band of sandstone weathering out along the top of the hill in irregular forms. This sandstone band can be traced from the middle of the section given above and is between the lower coal and the burnt seam of the middle of the exposure. The full section at the Taylor mine is found to be represented north along the banks of a small stream. In the mouth of a valley coming from Sec. 5, a road shows a section of about 25 feet of sandstone above water and it probably reached downward to within 10 or 15 feet of the coal seam of the mine.

The total section in the side valley and the mine could be represented by the following scheme:—

	Feet in.	Elevation. Above tide
Surface of prairie south edge of Sec. 5.	...	1862 6
Surface deposit.	4 0	
Yellow sandstone.	2 0	
Yellow clay	4 6	
Lignite partly burned at outcrop, mined at several points in the valley.	4 0	
Level of floor of tunnel.	...	1848
Whitish clay with some sandstone.	8 0	
Light yellowish clays and sands.	12 0	
Lignite.	6	
Bluish clays with several carbonaceous layers.	6 0	
Brown sandy ironstone.	1 0	
Drab clays, darker streaks of lignite	1 0	

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GEOLOGICAL SURVEY OF CANADA.



PERSPECTIVE OF MODEL LOOK

VOL. XV, PART F, PLATE IV.



MODEL LOOKING NORTH.

MA

	Feet in.	Elevation above tide.
Base of exposure.....		1819 6
Concealed to top of coal seam min'd nearby	8 0	1811 6
Coal, lignite.....	3 6	
Concealed to curb of well at about	8 0	
Sandstones in well, at least.....	25 0	
Sandstones exposed above the Taylor seam	14 0	
Top of coal at mine near river		1761
Lignite, Taylor seam.....	5 0	
Clays &c., to water of stream.	28 0	

Mr. Thompson the former manager of the Taylor mine informs me that in drilling by hand below the seam of the mine another seam of 22 inches of lignite was found and that for a considerable depth below that seam the measures were barren. This would agree with the record of the bore put down by Dr. Selwyn six miles to the east.

East of this there is a group of mines now in active operation on an eight feet seam which appears to be a continuation and combination of the seams of the lower horizon. In the Walsh mine there is reported a clay parting which is first developed in the Hassard mine just to the north. In this latter mine the seam dips to the west and the clay parting increases in that direction. To the east in the New Souris mine there is no clay parting and the seam maintains a thickness of eight feet and sometimes considerably exceeds that volume. The same may be said of the seam in the other mines to the east. There seems to be no doubt that the coal splits in going westward. This is also borne out in the mines near Estevan where this horizon is represented by several thin seams.

Mines on sections 33 & 34.
Tp. 1. R. 6.

Lower seam split by clay parting.

The section in the vicinity of the mines is well represented by the exposures on the steep hill east of the Walsh mine called the Sugar Loaf. The group of mines are all on the one seam and it is noted that there is a considerable difference in elevation at the several localities indicating an undulation of some magnitude. The following elevations arranged in order from the west will serve to show this:—

Undulation in beds at mines.

	Elevation.	
	8 ft. seam.	4 ft. seam.
	Feet.	Feet.
Taylor mine.....	1756	1848
Sugar Loaf	1768	1837
Souris mine.....	1766	1839
Farmer mine.....	1790	
Roche Percée mine	1797	
Trial pit east of mine.....	1788	
Bore hole on Sec. 35.....	1752	1812
Trial pit on Sec. 6 east.....		1823

That the seam slopes up to the north is shown in the bore made on the south east corner of Sec. 10. Here the elevations are, for the lower seam about 1783 and for the upper one 1848 or only 14 feet below the surface, while on Sec. 14 the upper one was not found at all, probably reaching the surface between the two places.

Section of the strata in the Sugar Loaf.

Sugar Loaf section at mines.	Surface	Feet in.	Elevation.
			1855
	Soil.....	0 6	
	Yellow sandy clays.....	5 5	
	Streak of lignite.....	0 2	
	Sandy clay with concretion and iron stone	7 5	
	Lignite.....	4 6	
	Clay and brown shale.....	1 10	
	Sandstone.....	2 2	
	Yellow clay some lignite.....	2 6	
	Yellow sandstone.....	3 10	
	Lignite.....	1 0	
	Dark clay.....	1 0	
	Light yellow sandstone.....	7 5	
	Streak of lignite.....	0 4	
	Yellow and gray clay.....	3 0	
	Top of middle seam.....		1814
	Lignite.....	1 0	
	Gray clay.....	1 3	
	Lignite.....	0 7	
	Gray clay.....	6 11	
	Lignite.....	0 3	
	Gray clay shale.....	0 6	
	Yellow to brown sandstone.....	1 6	
	Yellow and gray clay.....	2 0	
	Drab clay and shale.....	1 0	
	Yellow clay.....	0 4	
	Gray clay.....	1 3	
	Carbonaceous clay.....	2 0	
	Dark clay.....	2 6	
	Dark clay with streaks of lignite.....	3 7	
	Lignite.....	0 6	
	Gray clay.....	1 0	
	Yellow and gray sandy clay, with thin sandstone beds hardened 3 in.....	7 10	
	Shaly lignite.....	1 0	
	Clay.....	3 0	
	Top of lower coal.....		1776
	Coal seam.....	8 0	
		86 6	

At the Souris mine the coal is overlaid by sandstone in most of the exposures. Occasionally the rock is clay. Below the eight feet seam in

the Souris, another, two feet in thickness, is exposed at about five feet below, on the road between the Souris and the Farmer mine.

The eight feet seam has proved to be of a fair quality of lignite, and its thickness is ample to admit of economical working. It has been traced along the face of the valley on the north side from the Walsh mine to Sec. 35, and the bore put down near the centre of this section in 1902 proved its existence there, but east of this it has not been found. The levels given above show that in this part its surface is undulating; and eastward from the bore it is expected to dip to the east and go below the surface of the river-flat. Reducing the elevations to show the height above the bridge, crossing the river at the mines, will more clearly show the amount of rise and fall of the seam at its outcrop. At the Taylor mine it is about 18 feet above the bridge—at the Souris mine 40 feet—at the Farmer mine 64 feet—at Roche Percée mine 71 feet—at trial pit east of above mine 62 feet—at bore on Sec. 35, 26 feet. It is thus seen to be descending rapidly to the east from the latter point and it was looked for at an exposure on Sec. 36, a mile east of the bore-hole.

The river there cuts the bank and exposes over 100 feet. At the lower part are several holes made by the miners in trying to locate the lower seam apparently without success. The measures are not very well shown but the following section was made out:—

	Feet	In.	Elevation Above tide.
Top of point slightly back from the brink			1858
Concealed by grassy slope	20	0	
Sandstones partly hardened	56	0	
Top of upper coal seam			1782
Lignite	4	0	
Light gray clay and some sand	36	0	
Darker gray clay	24	0	
Concealed to river	6	0	
Water of river			1712

The upper seam is here only 66 feet above the river and to the north east in Sec. 6 at a distance of about a mile it has risen to 115 feet above the stream. This is probably the direction of the greatest dip. The lower seam might be expected to be present in the bank below this exposure, but more likely too low down to work. East of this it probably rises and might be found by digging, but the superficial deposits are found to be much more thickly strewn over the sides of the valley as well as on the upper surface, so that there are no exposures and the effort of individual miners is not equal to overcoming the increased thickness of this bouldery mixture.

SECTIONS ON SOUTHERN BANK OF SOURIS RIVER.

As the river here makes a bend to the north-east the sections on the south side should indicate the continuance of the seams a short distance. None of these exposures show the lower seam, but the best section is that given by Dr. Selwyn in St. Peters gully. This is probably the one that cuts through the eastern part of Sec. 25, township 1, range 6, judging from sketches in his note book. His barometer reading along the face of the bank and on the prairie above would place his lower seam at 63 feet above the Souris. Comparing this with the section I have given across the stream on the north bank, where the upper 4 feet seam is at 66 feet above the water, I am inclined to think that the lower coal of his section is the 4 feet seam above the one at the mines.

Sec. 25, Tp. 1,
R. 6.

Reducing the elevations to the known positions of the stream and the top of the bank, the section should be placed as below:—

St. Peters
gully.

Dr. Selwyn's section, St. Peters gully.

	Fest. in.	Above tide.
Top of bank.....		1751
Soil and sandy clay.....	10 6	
Lignite.....	3 0	
Base of coal.....		1856
Soft drab sandstone.....	9 0	
Ironstone band.....	0 8	
Soft drab sandstone.....	8 4	
Lignite.....	0 8	
Base of coal.....		1819
Sandy clay shale.....	8 0	
Ironstone with clay shale.....	1 6	
Sandy shale.....	8 4	
Sandy shale with carbonaceous streaks..	2 0	
Sandstone and concretionary sandrock with ferruginous bands and concretions.	9 0	
Clay shales.....	5 0	
Carbonaceous streak.....	1 6	
Clay shales, sandy.....	5 0	
Ironstone and shale.....	2 0	
Lignite (underlaid by stiff clay shale)...	3 0	
Bottom of seam.....		1775
	76 6	

Range 5.

While boring near here in 1880, Dr. Selwyn made an effort to trace these seams eastward to near the site of the bore-hole. His notes show that this seam rises rapidly to the north-east and that in the well section there was no chance of striking this series. The outcrops are all concealed, but by sinking a pit in the centre of Sec. 31, a seam

of lignite 3' 3" was uncovered at 103 feet above the stream. This Dr. Selwyn assumed to be the middle seam of the section above, and so expected to strike it just above the bore-hole farther east. The top seam he traced a short distance and supposed that it runs out to the surface. It is more probable however that this was the lower seam of his section and so would show about the same rate of rise as in the same seam on the north bank. The elevations for these localities, assuming all to belong to one seam are :

St. Peter's gully.	63 ft. above river
Centre of Sec. 36	66
Centre of Sec. 31	103
Trial pit on Sec. 6	115

These elevations do not allow of a single plane passing through them all, but show a rise to the north-east increasing north of line joining the second and third of the list above. Leaving out the first and projecting the plane passing through the others to the site of the bore-hole in the south-east corner of Sec. 6, township 2, range 5, it is found that the plane should there be at 138 feet above the river. This is near the top of the bank and taking the distance below that at which the lower 8 feet seam was found in the bore on Sec. 35, it would bring the probable position of the lower seam 86 feet above the river.

Both these heights are above the mouth of the bore and of a well or pit sunk by hand to strike the seam. The elevations here reduced to sea level are :—

	Feet.
Water of stream	1708
Surface at bore-hole	1767
Surface at pit 13 feet deep	1791
Estimated position of 8 feet seam	1794
Estimated position of upper 4 feet seam	1846
Top of bank	1854

The bore was sunk to a depth of 295 feet and at 272 feet or 1495 feet above tide, a seam six feet thick was reached. The details of this drilling are given in Dr. Selwyn's report for that year.*

The character of the coal is given in the same volume p. 811. For the sake of comparison with others of this field it is here repeated.

"Analyses by slow and fast coking gave the following results :—

* Report of Progress Geol. Surv. Can. 1879-80, p. 83

Coal from bore-hole.		Slow	Fast
		coking.	coking.
	Hygroscopic water.....	17.78	17.78
	Volatile combustible matter.....	29.51	32.70
	Fixed carbon.....	44.36	41.17
	Ash.....	8.35	8.35
		100.00	100.00

Ratio of volatile combustible matter to fixed carbon 1 to 1.50 1 to 1.26

Upper seam
south of river

On the south side of the river the exposures, with the exception of that given for St. Peters gully are not generally so easily made out. Coal has been mined on Sec. 26 in one of the gullies, probably from the seam represented in the lower part of the St. Peter section. A good exposure of this is seen in the railway cutting at the south-eastern corner of Sec. 34. Four feet six inches is the thickness at this point at an elevation for the bottom of the seam, of 103 feet above the bridge or 1829 feet above sea.

In the large branching side valley on Sec. 27 traces of this seam are seen occasionally at about this same elevation all around the eastern part. To the west it lowers somewhat and in the next depression which in plan is roughly leaf-shaped, it is being mined from an exposure on the hillside in Sec. 28 at an elevation of about 83 feet above the bridge. Along the south side of the main valley this seam, west of the long trestle, is not exposed but probably runs along above the railway cutting. A small seam is exposed in the cutting at about 70 feet above the river showing a slight dip to the west. This is probably represented in the Sugar Loaf by one of the middle seams.

Pure Lignite
mine.

The upper seam where mined on Sec. 28 is from 50 to 56 inches thick and is of very good appearance. The section here is not very extensive, only 27 feet of beds being seen.

Section at Knight and Carlson's Pure Lignite mine, N. W. quarter Sec. 28, Tp. 1, R. 6.

	Feet In.	Above tide.
Drab and yellowish clay at top.....		1819
Light yellow clay.....	4 0	
Dark gray clay.....	2 0	
Lignite.....	4 4	
Base of coal.....		1809
Sandstone.....	12 0	
Gray clay.....	4 0	
Lignite.....	0 10	
Bottom of exposure.....		1792
	36 10	

Burnt shales on the sides of the hills surrounding this large denuded tract indicate a former outcrop of this seam. But where these lines surround isolated hills it is probable that most of the coal has been burned away.

The sandstones below the seam which show along the side of the valley to the west and near Roche Percée are irregularly hardened so as to weather out in castellated forms so well described by Dr. Dawson, in the tract which follows:

"On the south side of the Souris valley, and a short distance to the east of the valley of Short creek, the Roche Percée group of rocks is situated.

"This locality has already been described by Dr. Hector and Captain Palliser who made a branch expedition to it from the north, in August 1857, being induced to do so by the reports of Indians and halfbreeds. These remarkable rocks which have long been objects of superstition to the Indians inhabiting the surrounding country, owe their curious forms to the weathering away of a soft gray sandstone from below a bed of similar rock which weathers yellow and is rendered durable by an abundant calcareous cement. Both the upper and lower sandstones show false-bedded structure in great perfection: though that in the upper hard portion, is on a smaller scale, owing to the thinner divisional planes of the rock. The capping sandstone is not hardened in a perfectly uniform manner, but in belts several yards in width, lying parallel in a northwest and southeast direction, and separated by spaces more easy of disintegration. There is also a system of cross-jointing nearly at right angles to this main direction."

"This combination of structure has given rise, under the long continued action of the weather, to the remarkably castellated, fantastic and picturesque rock scenery of this part of the Souris valley. The hard belts form tongues projecting diagonally from the grass-covered bank, and the erosion of the underlying soft sandstone, parallel to the cross joints, has, in several places produced window-like openings through them. The soft rock bears in many places rude Indian carvings, representing various animals and birds, strings of beads, etc."

The only trace of the lower seam was in the mouth of the gully at the northwest corner of Sec. 28 below the Pure Lignite mine on the upper seam. It is at about the level of the small stream which here crosses the railway and has been opened and probably mined for

Report on the Geology and Resources of the forty-ninth parallel by G. M. Dawson, Montreal, 1875, p. 86.

a short time, but as it is so low the water of the stream probably flooded the workings. Its elevation here is only three feet above the bridge or 1729 above sea.

Mouth of
Short creek.

Following the slopes west to the mouth of Short creek, the upper and middle seams are occasionally indicated by burned shales but no certain line of outcrop can be made out. It is very probable, however, that they are represented in the section at the mouth of the creek at Sutherland's mining location, measured by Dr. Selwyn in 1880. The exposure occurs at a sharp bend in the stream as it emerges from the narrow valley of Short creek and cuts into the east bank. The face of the bank is being rapidly eroded and slides are frequent, concealing the natural section. As the bank is only 90 feet high the section published by Dr. Selwyn is puzzling as it totals over 150 feet. This might be explained by supposing that the figures are in links and chains and also measured on the slope of the bank. Reduced as in the following it would agree better with what I was able to make out of the original section.

	Feet, in.
1 Soil and superficial drift	4 0
2 Sandstone or sandy clay	6 0
3 Lignite	2 0
4 Dark drab plastic clay shales	1 0
5 Lignite	5 0
6 Whitish soft sandstone	32 0
7 Lignite	3 0
8 Soft brown sandstone	11 0
9 Whitey brown sandstone (containing ironstone layer 6 to 7 feet thick in which were collected fossil leaves)	32 0
	96 0

Sutherland's
tunnel.

Several tons of coal were taken from a tunnel on the five feet seam in 1880 and shipped to Winnipeg, probably the first shipment of coal from this valley. A tunnel 78 feet in length having been driven, the coal was loaded upon barges and sent down the then swollen stream. Dr. Selwyn says of the coal:—* 'In the tunnel the lignite appeared to be solid and of good quality. The upper seam is only between 15 and 20 feet below the prairie level, and thus slight depressions in the surface would suffice to have caused its removal.' An analysis of this lignite was subsequently made in the laboratory of the Survey by Dr. Hoffmann who furnished the following report.†

* Report of Progress Geol. Surv. Can., 1879-80 p. 5A.

† Report of Progress Geol. Surv. Can., 1879-80 p. 9H.

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VOL. XV, PART F, PLATE V.

GEOLOGICAL SURVEY OF CANADA.



PERSPECTIVE OF MODEL, LOOKING SOUTH. SHORT CREEK AND COLLIES SOUTH OF MINES. FROM MODEL OF COAL FIELDS.
UPPER, MIDDLE AND LOWER COAL SEAMS.

A brownish black, compact lignite, ligneous texture very marked, lustre for the greater part dull, in more altered parts sub-resinous to resinous; tough; fracture on the whole uneven, occasionally, however, verging on the sub-conchoidal; does not soil the fingers, powder black, with a brownish tinge; it communicates a deep brownish red colour to a boiling solution of caustic potash; by exposure to the air becomes more or less fissured.

Coal of Upper horizon

Specific gravity 1.4168—Weight of one solid cubic foot 88.55 pounds.

Analyses by slow and fast coking gave as follows:

	Slow coking.	Fast coking
Hygroscopic water	21.84	21.84
Volatile combustible matter	32.15	35.12
Fixed carbon	41.61	38.64
Ash	4.40	4.40
	100.00	100.00
Coke, per cent	46.02	43.04
Ratio of volatile combustible matter to fixed carbon 1 to 1.29, 1 to 1.10		

SHORT CREEK.

Up the valley of Short creek several of the exposures show good sections of the rocks and coal seams. The first one of which I made an examination is on the south-west side of a long point running to the south-east from the north-west corner of Sec. 24. A section measured by Dr. Dawson near the crossing place of the Commission trail, must be near this, as the sequence of beds is very similar. The trail ascends the west bank and gains the prairie level near the cut-bank. The section as measured by Dr. Dawson is as below.

Sec. 24, Tp. 1
R. 7

	Feet in.	Approx. elev.
1 Soil	1 6	1840
2 Yellowish coherent sand, gray externally, and holding some much broken <i>Unio</i> -like shells at its base	12 6	
3 Gray clay	2 10	
4 Yellowish and thin bedded sands and sandy clays, with several very thin iron-stone layers, weathering orange-red externally.	6 0	
5 Gray clay	2 4	
6 Similar to No. 4 with decayed fragments of gastropod shells.	12 0	
15—F—3		

	Feet. in.	Approx. elev.
7 Also similar to No. 4 but with a great number of thin ironstone sheets	3	0
8 Hard yellowish sandy clay, a few inches at the top carbonaceous.	10	0
9 Good hard lignite.	2	2
10 Hard yellowish sandy clay	2	7
11 Good lignite.	4	9
12 Grayish sand and sandy clay, showing lines of stratification; in some places soft and incoherent, in others with large concretions, and sometimes forming a nearly solid sandstone.	9	0
13 Hard gray clay.	2	0
14 Grayish-yellow clay, with many thin layers of orange-weathering ironstone.	3	0
15 Lignite.	2	6
16 Grayish and yellowish hard sand and sandy clay.	11	0
Section concealed by slope of detritus, about.	12	0
	99	2 1740

To show the change in composition of beds, in even a short distance, the section measured in possibly the same bank near its eastern end is added below. The top beds bear the same general resemblance with perhaps an addition of another bed of sandstone at the top.

	Feet. in.
No. 8 of above section—Yellowish sandstone weathering very light, 5 to.	6 0
No. 9 of above section { Lignite	0 6
{ Brown carbonaceous shale.	2 6
No. 10 " " —Yellowish sandy clay.	5 0
No. 11 " " —Lignite.	5 2
No. 12 " " { Greyish sand and sandy clay.	6 0
{ Sandstone concretions.	2 0
No. 13 " " —Yellowish sandy clay.	6 0
No. 14 " " —Gray clay with lignite streak at top.	1 9
No. 15 " " —Lignite.	3 4
No. 16 " " —Concealed to water of stream, about.	10 0

The beds of this section were recognized in the field as bearing a great resemblance to those in the large gully on Secs. 28 and 29, and the seam at the Pure Lignite mine was then correlated with the one in the section numbered 11. This would also be the 5 feet seam at the mouth of the river, at Sutherland's tunnel. The lower seam does not again appear in any section above this on the creek. The others were traced to the mouth of the eastern branch—being then in the bed of the creek.

On Sec. 23 the seams are disclosed by a line of red burnt shale running on both sides at about the same elevation as on Sec. 24. Sandstone is seen in harder beds above the coal on the west bank and farther up the stream. A settler living on the north-east quarter of Sec. 14 has been digging in the bank for coal with poor success. First he opened a hole on the upper thin seam and it was very poor in quality. Again he started lower down and reached the horizon of the larger seam but it was all burnt out in the small hill in which he was digging. Under the steeper bank the burning probably will be found not to have penetrated very far. The burnt clays are at about 20 feet above the river.

In Sec. 11 there is a good exposure on the eastern bank. Near the water, a resident settler has opened a tunnel on the thicker seam and taken out coal for local use. The thickness of the seam is here seven feet and the coal appears to be of as good quality as most of that mined in the district.

Sec. 11, Tp. 1,
R. 7.

The following is a section of the beds :—

	Feet. in.	Approx. elev.
Surface deposit about	2 0	1870
Clays and clay ironstones.	5 0	
Clay and sand.	5 6	
Brown and gray clays with streak of lignite at top. .	4 0	
Brown and gray streaks of sandy clay with dark streak at top	5 0	
Yellow and brown clays with streaks of ironstone. .	3 0	
Dark brown shale	0 3	
Sandstone	12 0	
Gray and dark yellow clays, a few bands of red ironstone	22 0	
Small streak of lignite.	0 6	
Yellow sandstone not very much hardened	25 0	
Lignite	1 6	
Gray clay.	2 9	
Lignite	7 2	
Gray clay	3 0	
Lignite	0 4	
Clay to water of stream.	2 0	
	101 0	1770

In this the thickness of the main seam is greater than farther down the stream. The elevation above the water, only 5 feet, brings it below the general level of the river flat and the danger of flooding in the spring is much greater.

At the junction of Short creek and its eastern branch, a conical hill is situated in the centre of the branch and on the eastern edge of the larger valley. The waters of both streams nearly join above the hill but are deflected to the north. In high water the larger stream divides around the hill. In the channel thus made an outcrop of coal was discovered, being part of the thick seam of the section given just above. Only five feet of it could be made out, as the remainder, if any, was beneath the water of a pool. Three feet were above water and two or more below. In the banks, sandstones are exposed in almost the same section as farther up the east branch. Both north and south the clays at the bottom of the bank are reddened where the coal has been burnt.

Sections on the east branch of Short creek.

Grassy slopes conceal most of the rocks with the exception of two or three exposures where the sandstones are slightly harder and form steeper slopes. The first noted is at the southeast corner of Sec. 11 where the following order was observed:—

		Feet. in	Feet
Sec. 11, Tp. 1, R. 7.	Top of bank		1870 above tide
	Concealed by grassy slope	18	0
	Yellowish sandstone and streaks of clay	20	0
	Yellowish clay with a few sandy streaks	20	0
	Thin ironstone band lying on false bedded sandy clays	0	3
	Gray clays with <i>Unio</i> shells, top sandy	12	0
	Lignite	1	0
	Clay, gray to light yellow	4	0
	Sandstone to water of stream	10	0
	Elevation of water of stream about		1785
		80	3

Sec. 6, Tp. 1,
R. 7. The next exposure is at the centre of Sec. 6 on the north bank where sandy clays show in the bank, and 45 feet down, a tunnel is opened on a fair coal seam. In the tunnel the coal is from 57 to 60 inches thick with a clay parting of 8 inches separating it below from a smaller seam of 10 inches. The tunnel is about 14 feet above the water. This is probably the seven foot seam recorded by Dr. Selwyn, as being near the International boundary. As the banks lower very much in that direction and the seam maintains its position above the water the rocks of the upper part of the exposure run out. Another mine is opened on this seam a quarter of a mile east of the one noted above.

Section on the south-east quarter of Sec. 6, opposite a small branch from the south.

	Feet. in.	Feet.
Surface of prairie.....		1859 above tide Sec. 6, Tp. 1, R. 6.
Yellow clay and sand.....	22 00	
Ironstone.....	1 00	
Clay.....	7 00	
Lignite.....	4 06	
Clay.....	0 10	
Lignite.....	0 01	
Clay.....	0 07	
Lignite.....	0 08	
Concealed to water of stream.....	12 00	
Elevation of stream about.....		1810
	48 08	

Dr. Selwyn's note* on another exposure to the east of this is: 'To the south, a few yards north of where the International boundary crosses the east branch of Short creek, a seam is exposed in the bank seven feet thick, with a shaly parting of three inches, at about two feet from the top. It is not more than fifteen feet beneath the surface of the plain, and the drift covering is thin. Eight or ten feet below the seam is the water level of the creek.'

It can hardly be supposed that these seams are other than the ones exposed at a lower level in the main valley of Short creek. This would indicate a dip of the beds to the west which is also noted in the sections nearer the mouth in Sec. 24, with the exception, that in the north the sandstones separating the lower beds of coal from the one at Sutherland's tunnel thin out very much.

Evidence of this in the sections at the south can only be obtained by boring.

SOURIS RIVER FROM ESTEVAN SOUTHWARD.

The branch which here runs northward through the townships to the large valley passing to the south of Estevan is much newer in point of age than that which comes from the west in the larger valley. The amount of erosion which the southern branch has been able to accomplish is much less, but the channel it has worn down is deep and narrow. Cut banks are numerous but the superficial covering of drift is found to be much thicker away from the large valley on either hand, so that the sections as noted in many cases above, are obscured by the sliding down over their face of the finer grained material found in the drift.

* Report of Progress Geol. Surv. Can. 1879-80 p. 6A.

Grade of
stream.

The grade of the bed of the stream on this branch being in a new channel is much steeper than in the old valley. From the International boundary the fall is in the vicinity of one hundred feet. The grade is very uniform but steeper in the central portion or from Secs. 15 to 28. The sections as given above show that the stream has cut through and exposed all the seams that are seen in the vicinity of Estevan. The plotting of the sections also show that there is a perceptible rise in the beds toward the south.

Lower
horizon.

The lower horizon as exposed at Carrols on Sec. 14 is shown in Dr. Dawson's section (Paragraph 210) to consist of three seams, the upper one divided into two by a dark carbonaceous shale. The character of the lowest member is given in the following analysis*.

'Souris Valley.....Layer 19. A weathered specimen separating into laminae horizontally. Clay from overlying bed filling fissures. Ash yellow-brown.

Water.....	13 94	By rapid coking
Fixed carbon.....	45 27	38 35
Volatile combustible matter.....	35 00	
Ash.....	5 79	
	100 00	

These seams are also exposed in several places to the southern part of Sec. 28 where coal seams are found in the bed of the stream at a series of rapids.

Middle
horizon.

The middle horizon or the one supposed to be represented by the seam mined out in the hill south of the Dominion mine, is represented in Dr. Dawson's section by an upper seam of six feet six inches. This is probably good enough in quality for local use. The specimens analysed being weathered, the result is not promising.

'401 Souris Valley.....Layer 2. A weathered specimen, soft and crumbling. Ash, grayish-white.

Water.....	17 97	By rapid coking
Fixed carbon.....	32 86	30 10
Volatile combustible matter.....	44 56	
Ash.....	4 61	
	100 00	

This middle seam was opened near Sec. 9 by one of the settlers and the coal is said to be of fair quality. Burnt shales indicating

* Report on the Geology and Resources of the region in the vicinity of the Forty ninth Parallel, by G. M. Dawson, Montreal. 1875, p. 170.

its presence along the sides of the valley were seen at slightly higher elevations in going up the valley. On Sec. 33 the level of the burned shales is at about 1825 feet. No exposures of this seam are to be seen up to the southern part of Sec. 22, where it is given in the section quoted as having a thickness of 7 feet and 3 inches (Sec. 216). The analysis by Dr. Dawson shows it to be of good quality; better than the specimen from near the mouth of the river.*

'403 *Souris Valley*. . . . 7 foot seam. Hard compact black lignite, breaking with pseudo-conchoidal fracture, and showing traces of structure of wood. Ash, yellowish-white, light.

Water	15 11	By rapid coking
Fixed carbon	47 57	41 67
Volatile combustible matter	32 76	
Ash	4 56	
100 00		

On Sec. 14, Tp. 1, R. 8, it was opened by the Boundary Commission for use in the smithy. The analysis given by Dr. Dawson is as follows:†

'402 *Souris Valley*. Black compact lignite with much woody structure apparent. Ash yellow.

Water.....	14 73	By rapid coking
Fixed carbon	42 48	34 07
Volatile combustible matter	39 99	
Ash	2 80	
100 00		

The fall in the river here would indicate that if the seam did not rise much to the south it would probably cross the stream in Sec. 15 or perhaps a little further south. The grade of the river above this becomes much flatter indicating probably a more compact bed forming the floor for a short distance and the cut banks above this are covered by slidden clay from the surface. A good exposure was sought for in the almost circular bend in the bottom of which is situated the Mounted Police outpost Wood End. The banks surrounding this are all scarped but show only clay. The seam should be found near the water.

The upper horizon, represented at Estevan by the four foot seam and the Dorin seam, is not represented in the sections in the lower part of the narrow valley but makes its appearance in Sec. 33 just below

* See Boundary report as before, p. 171.

† Idem p. 170.

the boulder clay. Two miles farther south-east a burned seam on Sec. 27 is probably of this horizon and is seen again on Sec. 22. No good exposure of this is to be made out in Sec. 23, but Dr. Dawson found four feet of coal at about fifteen feet below the prairie level. (see paragraph quoted, 217 p. 45 F).

Details of sections.

Section at coal mine, south-east quarter of Sec. 11 Tp. 2 R. 8.

	Feet in.		Elevation. Feet.
Yellow sandstone	28 0	Top of hill behind mine	1836
Yellow clay	6	Top of exposure	1819
Light gray clay	5 0		
Lignite	6		
Light gray clay	3 6		
Lignite	6 0		
Reported below		Bottom of coal in tunnel	1776
Clay	1 0		
Lignite	5 0	Level of water in slough	1756

Sec. 11, Tp. 2,
R. 8.

One of the men who opened this seam and the tunnel to test the coal, Mr. Rook of Estevan, informs me that below the six foot seam they found a clay parting of 12 inches and a five foot seam of very good lignite beneath. The coal that was taken out of this tunnel is admitted by several in the town to have been the best in quality of any mined in the district near Estevan.

Near the western edge of Sec. 11, the clays and sands exposed on the eastern part of the same section above the coal are again seen, but the upper part of the series is somewhat different. The exposure does not show the coal although it is probably present beneath the grassy slope.

	Feet in.	Elevation. Feet in.
Top of exposure		1806 6
Gray clayey sandstone	25 0	
Ironstone band	2	
Gray clay	1 0	
Brown clay	1 0	
Lignite	4	
Gray clay, brown at top	3 0	
Bottom of exposure		1776

A little farther to the west where the stream enters the larger valley, on the point and just inside the bend on Sec. 10, the lower coal seams are partly exposed. The surface is decomposed and the thickness of

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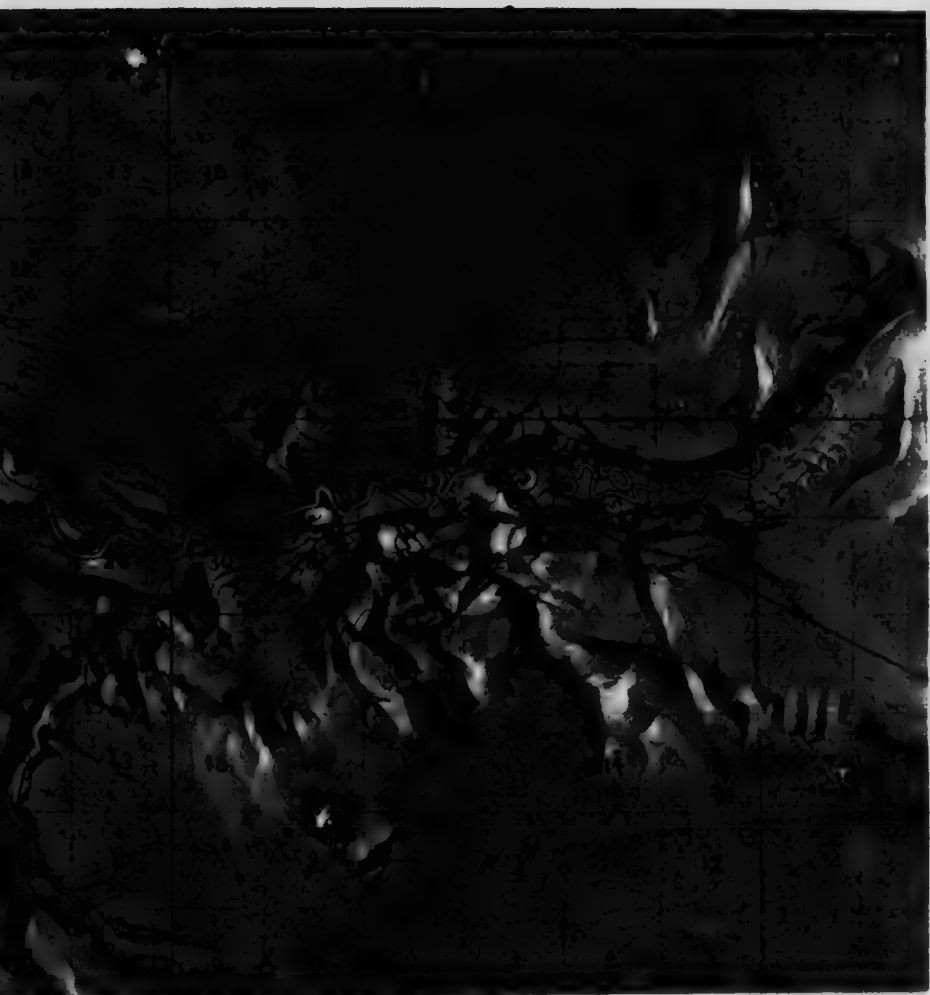
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GEOLOGICAL SURVEY OF CANADA.



PHOTO. OF MODEL OF SOURIS COAL FIELD, BY
Scale approximately 2 m



FIELD, BY D. B. DOWLING. LIGHT FROM LEFT.
approximately 2 miles to the inch.



the seams is not well brought out. There appear to be two or three of them, but all rather thin. At about 70 feet above the river, a red band shows where a seam has been burned out. This may be the middle seam of the section across the river. It would be here at about 1820 feet above sea. A few feet of hardened sandstone show at about 1836 feet.

This burnt seam is not shown in the section at the mine, a mile to the east and is probably above the beds there exposed. The yellow sandstone there seen is not represented in this section, nor is it seen near Estevan and is probably not a persistent member.

The sections given by Dr. Dawson, though not very exact as to location are carefully measured and that given on p. 89 of the report on the Geology and Resources of the 49th Parallel, is perhaps taken at the bend in Sec. 10, where we noted a similar arrangement of the beds.

The paragraph referring to this locality is as below:

"209. Six miles north from Wood End Depot, on the bend of the river, the following section occurs:—

	Feet.
1 Fallen bank, no section, (about).....	8 0
2 Finely stratified grayish sandy clay.....	7 6
3 <i>Lignite</i>	0 7
4 Sandy clay, grayish, laminated, including two leaf beds each a few inches thick.....	7 7
5 Yellowish fine sandy clay passing below to gray soft sandstone.....	11 5
6 Ironstone, a nodular layer.....	0 3
7 Gray clay.....	1 0
8 Whitish clay.....	1 0
9 Carbonaceous shale.....	3 3
10 Gray clay.....	3 6
11 Ironstone.....	0 2

45 9

The beds appear to be perfectly horizontal. Those of sand and arenaceous clay, though having the appearance of well characterized layers at a little distance, and giving the banks a ribboned aspect are found, on closer examination, to pass almost imperceptibly into each other. This peculiarity is often to be observed in almost all localities where these rocks are found. The so-called leaf beds are of a grayish purple tint, and contain many impressions of flag-like, parallel-veined leaves, which, though distinct enough when freshly taken from the bank, are impossible to preserve on account of the crumbling nature of the matrix. The ironstone, though generally forming extensive sheets, is nodular in structure, and varies a good deal in thickness. It

weathers a bright brownish red, is hard, compact, and very heavy, and on fresh fractures is bluish to yellowish gray.

At a short distance south of this locality, the bank shows the following section very perfectly:—

	Feet in.
1. Mixed shale and drift	7 0
2. Lignite	6 8
3. Grayish sandy clay	4 0
4. Lignite	1 6
5. Grayish and yellowish well-stratified fine sandy and shaly clays	14 0
6. Ironstone (massive)	0 4
7. Grayish and whitish clays	2 0
8. Carbonaceous shale	1 0
9. Gray soft sandstone	1 8
10. Lignite	1 0
11. Gray and yellow laminated sandy clays	5 0
12. Ironstone (nodular)	0 3
13. Lignite	1 7
14. Carbonaceous shale	1 6
15. Lignite	2 2
16. Gray sandy clay	2 0
17. Lignite	1 5
18. Sandy underclay with large and small roots badly preserved	1 6
19. Lignite	3 2
20. Grayish sandy clay	

57 7

The lower lignite beds are of excellent quality, firm and compact, and in some places show spots of fossil resin. The structure of the component wood is also in many instances very plainly apparent. The upper lignite, lying immediately below the surface, is soft and decomposed where exposed, being in many places penetrated by roots from above. It might however, prove equally compact with the lower beds where undisturbed. Layer 18, is one of the few instances in which lignite was observed to lie upon an evident underclay with roots. The ironstones are specially good and compact in this section. Owing to the wearing away of the softer strata, a large quantity of this material strewn the surface of the hillside.

Of the sections quoted above, the first appears to bear great resemblance to that given as exposed on the western part of Sec. 11, with the exception that the measures between the two ironstone bands are there somewhat thinner. The section above, which appears to have been in the narrow valley is evidently continued to a lower level and so shows the coal seams which are covered on the more easy slope of

the wide river flat. The upper coal seam of the section, 6 feet 6 inches in thickness, is probably now burned along the outcrop and appears again at an improvised lime kiln where the elevation of the burnt seam is at 1820 feet. This is no doubt higher than that of the seam in Dr. Dawson's section and would show a slight rise to the south. This is about equal to the rise of the bed of the stream for a short distance.

C., the north part of Sec. 23, the eastern bank shows a small outcrop near the top and again near the stream. Sec. 23, Tp. 1,
R. 8.

	Ft. above tide.
Surface of prairie	1888
Boulder clay 5 feet on part of a seam of lignite (6 in. showing)	1875
Covered to	1830
Sandstone red burned 5 feet	
Probable burnt seam.	1825
Covered to	1785
Clay ironstone band.	1785
Several thin coal seams as on Sec. 10	
Level of stream.	1775

The section given by Dr. Dawson in paragraph 212 of the report cited is probably near this and is as follows.

'212. Nearly three miles southward from the last mentioned locality, in following up the valley, another very good section occurs on the east side of the stream, where in one of its many devious windings, it has undermined the bank. This section is specially interesting, as affording one of the best localities for the collection of shells of Mollusca characteristic of the formation. The section is as below, measurements being estimated:—

	Feet. in.
Sand and sandy clay, stratified and yellowish in general colour	40 0
Lenticular mass of poor clay ironstone running out rapidly in both directions.	2 6
Gray sand	2 0
Shell bed.	1 6
Lignite	2 0
Sand and clay	10 0
	58 6

'213. The shell bed is of hard gray sandy clay and in some places is very full of shells, which are also less crushed and in better state of preservation than is usual in this formation. The most common Mollusk is *Melania Nebraskaensis*, M. & H. which occurs in all stages of growth and several varietal forms. There is also a second species of this genus or of *Goniobasis*; fragment of *Unio* and *Paludina* and a few examples of

NOTE.—*Melania Nebraskaensis* is now called *Goniobasis Nebraskaensis*.

Corbula (*Potamomya*), *mastriformis* M. & H. The latter must be considered a brackish water type, but with this exception, no brackish or salt water forms are found in these sections of the Souris valley. The Mollusca exactly resemble those of the Fort Union or Great Lignite Group of the Missouri, and fix with certainty the stratigraphical position of the beds here represented.¹

Secs. 33 and 27

From the bend in Sec. 33, southward, the top seam is seen to be burned along the edge of the bank. On the west bank at the bend the section is greatly concealed by sliding clay—the face showing gray clay but near the base the dark clay and ironstone is very like that in the lower part of the sections near Estevan. At the south-west corner of Sec. 27 the top of the bank is at 1890 feet. A burned seam is seen at 1865 and in the river bed at 1800 two feet of one of the lower seams show in the water.

Sec. 22.

On Sec. 22, near the centre, a cut-bank on the east side, shows the following—

	Ft. above tide.
Top of bank.....	1890
Band with a little lignite (prob. burnt seam of Sec. 27).....	1870
Top of yellow sands and sandstone.....	1855
Bottom of sandstone.....	1845
Traces of lignite below.....	

On the south-east corner of this Sec. is the exposure on the west side of the stream that is recorded by Dr Dawson in paragraph 215. As I could not cross the stream his section is given below with the probable elevations added so as to compare with my sections :

215. South of the last section and about one mile nearly due north of the position occupied by Wood End Depot, an exposure, showing the most valuable lignite bed I have seen in the Souris valley, is situated. The beds are arranged thus :—

	Ft. in.	Est. elev.
1 Drift material (about).....	8 00	1890
2 Yellowish and gray stratified sandy clays, obscured in most places by slips of the bank.....	52 00	1838
3 Lignite.....	7 03	1831
4 Gray soft arenaceous clay.....	1 00 or more	

216. The bottom of the lignite is about twenty-five feet above the level of the river below, and this part of the section, though apparently consisting of yellowish sandy clays like those overlying it, is obscure. The lignite is continuously visible for at least two hundred feet along the face of the bank, and seems to preserve uniformity of character and thickness.

'Externally it is often crumbling, and mixed with clay which has penetrated its joints from above; but where freshly exposed; it is hard and compact. It is quite black on freshly fractured surfaces, but has a brown streak, and in many places the structure of the original wood is quite discernable. Some surfaces are strewn with fragments of mineral charcoal like that found in many true coals. Other specimens are apparently structureless, and resemble cannel-coal in appearance though not in composition. The upper beds of arenaceous clay yield a few poorly preserved shells (*Paludina*, &c.)

'217. On the opposite side of the river valley, near this place, the upper part of the bank shows a good section of arenaceous clay, below which, and some fifteen or twenty feet below the prairie level is a seam of lignite of good quality, four feet in thickness. This lignite bed would seem to occupy a position stratigraphically superior to the last.'

Sec. 23, Twp. 4,
R. S.

This section in the above paragraph (217) is probably on the south west corner of Sec. 23. The bank is well cut showing about forty-five feet of clays and dark yellow sands near the top. There are two lignite exposures in the bank, but we could not dig out a good section owing to the fact that a great deal of it had been burnt. There is a broad patch of red burnt clay at thirty-five feet above the stream. This must be about the horizon of the seam observed by Dr. Dawson across the river. At 1880 feet or about 10 or 12 feet below the prairie level there is another lignite streak but at the only point at which I could reach it most of the coal had been burned. This is no doubt the four feet seam of the paragraph above.

On Sec. 14 on the east bank near the centre of the Sec. the lower lignite again outcrops about 15 feet above the stream. While the Boundary Commission had a depot near this place coal was taken from this seam for the smithy, but Dr. Dawson observes that it did not give a sufficiently intense heat for welding.

Sec. 14.

The sandstones above the lower coal seam outcrop again on Sec. 15 but the banks above this are not so high and are generally grass-grown. In Sec. 4 there is a cut-bank 40 feet high, but it shows mostly drift material. In Sec. 6 the banks are only thirty feet high and show only sands and clays slidden from the surface.

Secs. 15 & 4.